
प्लास्टिक — पॉलीक्रिलामाइड सामग्री — पदनाम और विशिष्टि

Plastics — Polyacrylamide Materials — Designation System and Specification

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FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards, after the draft finalized by the Plastics Sectional Committee had been approved by the Petroleum, Coal and Related Products Division Council.

Polyacrylamide (PAM) is not a name given to a single product but is the name given to a family of synthetic organic polymers with varying properties made solely from acrylamide or from acrylamide and other co-monomers. PAM used for oil and gas applications are also often called partially hydrolysed polyacrylamide (PHPA). PAM is commercially available in the following forms:

<i>Form</i>	<i>Other terms used</i>
Dry	Flake, Powder, Granular, Bead
Emulsion	Liquid, Dispersion, Inverse emulsion
Solution	Liquid, Aqueous solution, Viscous solution
Aqueous Dispersion	Oil-free emulsion, Water dispersion, Brine dispersion
Gel	N/A

PAM generally carry an anionic, non-ionic, cationic, or amphoteric charge (having both anionic and cationic charge) which depends on the monomer composition:

<i>Charge</i>	<i>Common Monomers Used</i>
Anionic	Acrylamide + Anionic Monomers: Acrylic Acid, ATBS, etc.
Non-ionic	Acrylamide
Cationic	Acrylamide + Cationic Monomers: DMAEA, DAC, etc.
Amphoteric	Acrylamide + Anionic Monomer(s) + Cationic Monomer(s)

Polyacrylamide are used, for example, as flocculants in water and wastewater treatment and also for several other applications including as viscosifying agents and friction reducing agents, to name some of their popular uses.

<i>Charge</i>	<i>Common Applications</i>
Anionic	Wastewater treatment, sugarcane juice clarification, enhanced oil recovery, friction reducing agent, paper production, erosion control, etc.
Non-ionic	Wastewater treatment, mining, agriculture, etc.
Cationic	Sewage treatment, textile processing, paper production, etc.
Amphoteric	Paper production, etc.

There are various methods of producing PAM and differ depending upon the form, charge, and application. In general, the processes can be divided into co-polymerization method, hydrolysis method, and reaction method.

Some of the main properties of PAM are molecular weight, charge, and charge density. However, there are other properties which are of importance depending upon the type and application. The properties can be controlled through factors such as polymerization conditions, monomer ratios, etc. It is very important to note that the physical characteristics of PAM do not necessarily signify their usefulness for specific application. Product performance can only be measured against specific applications which may differ from customer to customer and can only be ascertained through application testing in labs, pilot studies, and/or plant trials.

(Continued on third cover)

Indian Standard
**PLASTICS — POLYACRYLAMIDE
MATERIALS — DESIGNATION SYSTEM
AND SPECIFICATION**

1 SCOPE

This Standard establishes the designation system, prescribes the requirements, methods of sampling and test for Polyacrylamide material.

2 REFERENCES

<i>IS No.</i>	<i>Title</i>
2828 : 2019/ISO 472 : 2013	Plastics — Vocabulary

3 TERMINOLOGY

For the purpose of this standard, the definitions given in IS 2828 shall apply.

The Indian standards listed below contain provisions which, through reference in this text, constitute provision of this standard. At the time of publication, the edition indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards listed below.

4 DESIGNATION SYSTEM

4.1 General

4.1.1 Designation code for Polyacrylamide material shall be done based on five data blocks. The designation shall consist of following information given in the order presented and shall be codified in different blocks as indicated below:

Data Block 1	For Indian Standard
Data Block 2	For the material identification
Data Block 3	For intended application or method of processing, important properties, additives, and supplementary information
Data Block 4	For designatory property
Data Block 5	For additional information

4.1.2 Each data block shall be separated by space or hyphen.

4.1.3 If a data block is not used, this shall be indicated by double comma (,,).

4.1.4 In case of data block 5, as it is for additional information, if no information is to be specified, double comma (,,) may or may not be used.

4.2 Designation System Codification

4.2.1 Data Block 1

For Indian Standard.

4.2.2 Data Block 2

In this data block, the different forms of PAM used for different types of applications are designated by single character as given in Table 1. The form of the material is tested by visual appearance (Physical appearance) as given in column 4 of Table 1.

Table 1 Code Letters Used in Data Block 2
(Clause 4.2.2)

Sl No.	Code	Physical Forms of PAM	Physical Appearance
(1)	(2)	(3)	(4)
i)	A	Dry	White to pale yellowish, granular free flowing powder.
ii)	B	Emulsion	Milky white viscous liquid, no phase separation on standing.
iii)	C	Aqueous Solution	Colourless to slightly yellow transparent viscous solution
iv)	D	Aqueous Dispersion	Heterogeneous mixture of a fluid that contains solid particles sufficiently large for sedimentation. The particles may be visible to the naked eye, usually must be larger than one micrometre, and will eventually settle.
v)	E	Gel	Apparently Transparent to Hazy, solid, jelly-like materials.

4.2.3 Data Block 3

In this data block, the different ionic characteristics of different types of PAM are designated by three

character. Two characters are used to designate the ionic characteristics as per Table 2 and one character is used to designate the charge density as per Table 3.

Table 2 Code Letters Used in Data Block 3
(Clause 4.2.3)

Sl No.	Code	Charge
(1)	(2)	(3)
i)	AN	Anionic
ii)	CT	Cationic
iii)	AM	Amphoteric
iv)	NC	Non-ionic

Table 3 Code Letters Used in Data Block 3
(Clause 4.2.3)

Sl No.	Code	Charge Density	For Anionic	For Cationic and Amphoteric		
			Mole Percent of Anionic Monomers in Active Polymer	CE Value (meq/gm)	Mole Percent of Cationic Monomers in Active Polymer	CE Value (meq/gm)
(1)	(2)	(3)	(4)	(5)	(6)	(7)
i)	W	Weak	≥ 5 percent and < 20 percent	-0.25 to - 2.5	< 30 percent	0.0 – 3.5
ii)	M	Medium	≥ 20 percent and < 50 percent	-1.8 to -5.5	≥ 30 percent and < 60 percent	3.0- 6.5
iii)	S	Strong	≥ 50 percent	≥ -5.0	≥ 60 percent	≥ 6.0
iv)	N	Non-ionic	N/A			

NOTES

1 Either the mole percentage method or the CE Value may be used.

2 In case of anionic copolymers, the mole percent of the anionic monomer or the hydrolyzed acrylamide groups contained in the active polymer shall be used.

3 In case of cationic and amphoteric copolymers, the mole percent of the cationic monomer contained in the active polymer shall be used.

4.2.4 Data Block 4

In this data block, the range of average molecular weight and percentage of solid content are designated by two character. At position one, the

range of average molecular weight is designated by single character as given in Table 4 and at position 2, the total solid content is designated by a single number as given in Table 5.

Table 4 Code Letters Used in Data Block 4
(Clause 4.2.4)

Sl No.	Code	Molecular Weight Range	For Anionic and Non-ionic Molecular Weight (M_w) of Active Polymer in g/mol	For Cationic and Amphoteric - Molecular Weight (M_w) of Active Polymer in g/mol
(1)	(2)	(3)	(4)	(5)
i)	L	Low	≤ 10 million	≤ 4 million
ii)	M	Medium	> 10 million and ≤ 20 million	> 4 million and ≤ 8 million
iii)	H	High	> 20 million	> 8 million

NOTE — Any known test method such as capillary flow viscosity, Brookfield UL rotational viscosity, etc. may be used to calculate the average molecular weight.

Table 5 Code Letters Used in Data Block 4
(Clause 4.2.4)

Sl No.	Code	Total Solid Content
(1)	(2)	(3)
i)	9	≥ 90 percent
ii)	8	≥ 80 percent
iii)	7	≥ 70 percent
iv)	6	≥ 60 percent
v)	5	≥ 50 percent
vi)	4	≥ 40 percent
vii)	3	≥ 30 percent
viii)	2	≥ 20 percent
ix)	1	≥ 10 percent
x)	0	< 10 percent

4.2.5 Data Block 5

Indication of additional requirements in this optional block is a way of transforming the designation of a material into a specification for a particular application. This may be done for example by reference to a suitable published Indian standard.

4.2.5.1 If the PAM material is used for potable water, food stuff and pharmaceuticals and the permissible limit of residual acrylamide monomer in active polymer is less than 500 ppm (0.05 percent), when tested as per Annex D, the material may be marked with a code PWG.

4.2.5.2 The Bulk Brookfield viscosity may be given for the material at 25 °C and coded as given in Table 6 and shall be determined as per Annex E. Bulk

Brookfield Viscosity is applicable for emulsions, aqueous solution, and aqueous dispersions.

Table 6 Code Letters Used in Data Block 5
(Clause 4.2.5.2)

Sl No.	Code	Bulk Brookfield Viscosity (cps)
(1)	(2)	(3)
i)	1	< 300
ii)	2	≥ 300 and < 500
iii)	3	≥ 500 and < 1 000
iv)	4	≥ 1 000 and < 5 000
v)	5	≥ 5 000
vi)	0	Not declared

NOTE — The supplier may select their own model and spindle, and an RPM of 12 should be used as far as practicable.

4.2.5.3 Solution Viscosity range may be given for the material at 25 °C and coded as given in Table 7

and shall be determined as per Annex F. This is applicable only to solids and gels.

Table 7 Code Letters Used in Data Block 5
(Clause 4.2.5.3)

Sl No.	Code	0.1 Percent Aqueous Solution Viscosity (cps)
(1)	(2)	(3)
i)	1	≥ 10 and < 100
ii)	2	≥ 100 and < 250
iii)	3	≥ 250 and < 350
iv)	4	≥ 350 and < 450
v)	5	≥ 450
vi)	0	Not declared

NOTE — The supplier may select their own model and spindle, and an RPM of 30 should be used as far as practicable.

4.3 Coding Example

There will be no space or hyphen between two alphabets/number within a block except data block

1, but each data block will be mentioned and separated by a space or hyphen. Each data block is restricted with maximum number of letter/numbers as mentioned below:

Data Block 1	IS 18103
Data Block 2	Maximum 1 character
Data Block 3	Maximum 3 character (2 for ionic characteristic and 1 for charge density)
Data Block 4	Maximum 2 character (1 for molecular weight and 1 for solid content)
Data Block 5	Maximum 4 character

5 EXAMPLES OF DESIGNATIONS

5.1 Emulsion based polyacrylamide material (B) having a cationic charge (CT) with a medium charge density (M) (≥ 30 percent and < 60 percent mole percent of Cationic monomers in active polymer) with a high molecular weight (H) (> 8 million

molecular Weight (MW) of active polymer in g/mol) with a total solid content of 70 percent (7) and having residual acrylamide monomer in active polymer less than 500 ppm would be designated:

Indian Standard number Block 1	Block 2	Block 3	Block 4	Block 5
IS XXXXX	B	CTM	H7	PWG
Data Block 1				
Data Block 2: Form of PAM				
Data Block 3: Ionic Characteristics Charge Density				
Data Block 4: Position 1: Molecular weight Position 2: Total solid content				
Data Block 5: Additional Property				

Designation: IS 18103-B-CTM-H7-PWG

6 REQUIREMENTS

6.1 The physical form of the material shall be declared by the manufacturer and shall be designated as per Table 1, as agreed between purchaser and supplier.

6.2 The ionic characteristics of the material shall be declared by the manufacturer and shall be designated as per Table 2, as agreed between purchaser and supplier.

6.3 The charge density of the material shall be designated as per Table 3, based on the value as agreed between purchaser and supplier.

The charge density of the material shall be determined in terms of CE value (meq/gm) when tested as per Annex A.

6.4 The molecular weight of the material shall be designated as per Table 4, based on the value as agreed between purchaser and supplier. The molecular weight shall be determined as per Annex B.

6.5 The solid content of the material shall be designated as per Table 5, based on the value as agreed between purchaser and supplier. The solid content shall be determined as per Annex C.

7. PACKING AND MARKING

7.1 Packing

The material shall be packed in suitable form of packing, as agreed to between the purchaser and the supplier.

7.2 Marking

7.2.1 Each bag and/or unit package whichever is smallest in size that is being delivered to the customer shall be clearly marked with the following:

- a) Name and type of the material;
- b) Designation code;
- c) Net mass of the material;
- d) Batch number/Lot number;
- e) Month and year of manufacture of the material;

NOTE — Batch number/ Lot number may reflect Month and Year of Manufacture of the material. If not, it has to be printed separately as mentioned in (e).

- f) Shelf life;
- g) Name of the manufacturer and trademark, if any; and
- h) Any other statutory requirements.

7.2.2 BIS Certification Marking

The product(s) conforming to the requirements of this standard may be certified as per the conformity assessment schemes under the provisions of the Bureau of Indian Standards Act, 2016 and the Rules and Regulations framed thereunder, and the products may be marked with the Standard Mark.

8 SAMPLING

8.1 GENERAL

In drawing, preparing, storing and handling samples, the precautions and directions given in **8.1.1** to **8.1.6** shall be observed.

8.1.1 Samples shall be collected in a closed environment.

8.1.2 The sampling instrument shall be of stainless steel or any other suitable material on which the material shall have no action. The instrument shall be clean and dry.

8.1.3 Precautions shall be taken to protect the samples, the materials being sampled, the sampling instrument and the containers for samples from adventitious contamination.

8.1.4 The samples shall be placed in a suitable clean, dry, air-tight, plastic/metal/glass container on which the material has no action. The sample container shall be of such a size that it is almost completely filled by the sample.

8.1.5 Each sample container shall be sealed air-tight with a stopper after filling and marked with full details of sampling, such as the date of sampling, the month and year of manufacture of the material, etc.

8.1.6 Samples shall be stored in such a manner that the temperature of the material does not vary unduly from the normal temperature.

8.2 Scale of Sampling

8.2.1 Lot/Batch

8.2.1.1 For continuous chemical processes like polymer production, the sampling shall be done from sealed bags/packages or other representative sampling points after proper homogenization of the material.

8.2.1.2 To get the representative samples from the entire lot/batch, random sampling to be done from the entire lots/batches irrespective of the size of lot/batch. The number of sampling to be done as per Table 5 based on the quantity of the lot/batch.

Table 5 Number of Containers to be Selected for Sampling
(Clause 8.2.1)

Lot Size (Tonnes)	Number of the Sealed Bag/Package for Sampling
(1)	(2)
Up to 10	3
> 10 to 100	4
> 100	5

8.2.1.3 Approximately 1 kg (or higher quantity required for testing) of sample collected from each of the above sealed bag into a clean plastic bag to have approximately 3 kg composite sample. Proper mixing to be done for homogenization of composite sample before testing.

8.2.1.4 Based on the requirement of testing, the portion of the composite sample shall be stored properly in two containers as mentioned in **8.1.4**. Sample of the one container shall be used for testing in front of inspection authority at manufacturer site/laboratory. The other sample container shall be stored (maximum 6 months) and properly labelled as a reference sample for testing in future if it is required in case of any dispute or other requirement.

8.3 Sampling Instrument

8.3.1 The sampling instrument made of stainless steel shall be as shown in Fig. 1. It shall be capable of taking samples from all points when inserted into the container/bag. In case of multilayer film sack (FFS bag) sampling may be done by opening the bag and collect the sample.

8.3.2 From each of the containers/bags selected, portions of the material shall be drawn with the help of the sampling instrument. The total quantity of the material collected from each container/bag shall be sufficient to conduct tests for the determination of the various characteristics as required.

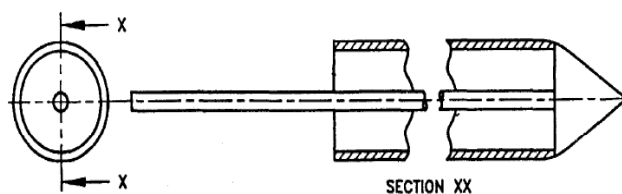


FIG. 1 SAMPLING INSTRUMENT

8.4 Number of Tests

8.4.1 Tests for the determination of charge density, molecular weight and solid content shall be conducted individually from a portion of composite samples, kept in the bottle/container.

8.5 Criteria for Conformity

a) Each of the test results for charge density, molecular weight and solid content shall satisfy the corresponding requirements given in **6.3**, **6.4** and **6.5**.

ANNEX A

(Clause 6.3)

MEASUREMENT OF CE VALUE (COLLOID EQUIVALENT VALUE) FOR ANIONIC POLYMER

A-1 PRINCIPLE

This test method is used to measure the charge density of PAM by measuring the CE value of the material.

A-2 APPARATUS

A-2.1 Burette or Automatic Titration Analyzer

A-2.2 Electronic Balance

A-2.3 Jar Tester (Stirring Dissolver)

A-2.4 Magnetic Stirrer and Stirring Bar

A-2.5 pH Meter

A-2.6 Griffin Beaker, 500/200 ml

A-3 REAGENT

A-3.1 N/400 PVSK Solution for colloid titration grade

A-3.2 N/200 Methyl Glycol Chitosan for colloid titration grade

A-3.3 Toluidine Blue Indicator

A-3.4 N/10 NaOH

A-3.5 N/100 HCl

A-4 PROCEDURE

A-4.1 For Anionic Polymer

A-4.1.1 Dissolve 0.44 gm sample to 400 gm pure water while stirring at 400 rpm for 90 minutes. Use jar tester to stir at 400 rpm.

A-4.1.2 Dilute the 0.1 percent sample solution 5.0 gm with 145 gm pure water.

A-4.1.3 Add 0.5 ml N/10 NaOH and stir it.

A-4.1.4 Add 5 ml N/200 Methyl glycol chitosan and stir it more than 5 minutes.

A-4.1.5 Adjust pH of the above solution to 10.5 ± 0.1 by adding N/10 NaOH or N/100 HCl.

A-4.1.6 Add few drops of toluidine blue indicator.

A-4.1.7 Titrate with N/400 PVSK by using burette.

A-4.1.8 End point change in colour from blue to pink.

A-4.1.9 For blank test use 5.0g of pure water instead of 0.1 percent sample solution and analyse with same manner.

A-4.2 For Cationic Polymer

A-4.2.1 Dissolve 0.44 gm sample to 400 gm pure water while stirring at 400 rpm for 90 minutes. Use jar tester to stir at 400 rpm.

A-4.2.2 Dilute the 0.1 % sample solution 5.0 gm with 145 gm pure water.

A-4.2.3 Add 0.5 ml N/100 HCl and stir it.

A-4.2.4 Add 5 ml N/200 Methyl glycol chitosan and stir it more than 5 minutes.

A-4.2.5 Adjust pH of the above solution to 3.3 ± 0.1 by adding N/10 NaOH or N/100 HCl.

A-4.2.6 Add few drops of toluidine blue indicator.

A-4.2.7 Titrate with N/400 PVSK by using burette.

A-4.2.8 End point change in colour from blue to pink.

A-4.2.9 For blank test use 5.0 g of pure water instead of 0.1 % sample solution and analyse with same manner.

A-5 CALCULATION

$$\text{CE Value} = [(B) \cdot f \cdot (1/400)] / [S \cdot (NV/100) \cdot (L/400)]$$

where

A — Titration reading (ml) of N/400 PVSK solution for sample;

B — Titration reading (ml) of N/400 PVSK solution for blank test;

f — Factor of N/400 PVSK solution;

S — Weight of sample taken for 0.1 percent sample solution preparation;
L — Weight of (gm) of 0.1 percent sample solution; and

NV — Solid content (weight percent) of sample.

ANNEX B (Clause 6.4)

DETERMINATION OF MOLECULAR WEIGHT

B-1 PRINCIPLE

This test method is used to measure the molecular weight of PAM by measuring the viscosity of material. Two methods have been mentioned in this Annex to measure the molecular weight.

B-2 METHOD 1

B-2.1 The manufacturer may use any known test method such as capillary flow viscosity, Brookfield UL rotational viscosity, etc. to calculate the intrinsic viscosity of the material which will be used to determine molecular weight (Viscosity Average, M_w) by using Mark-Houwink empirical correlation for a given salt at specified temperature (PAM in 0.05M NaNO_3 at 30°C). The Mark-Houwink correlation is as follows:

$$\eta = K \times (M_w)^a$$

where

M_w = molecular weight (viscosity average)

η = Intrinsic Viscosity

$K = 0.0063$

$a = 0.800$

B-3 METHOD 2

B-3.1 This method is used to measure the molecular weight of the material by measuring the viscosity of 0.1 percent Aqueous salt solution.

B-3.2 Apparatus

B-3.2.1 Brookfield Viscometer with UL Adaptor

B-3.2.2 Constant Temperature Water Bath

B-3.2.3 Electronic Balance

B-3.2.4 Jar Tester (stirring dissolver)

B-3.2.5 Magnetic Stirrer and Stirring Bar

B-3.2.6 500 ml Griffin Beaker, 200 ml Tall Beaker

B-3.3 Procedure

B-3.3.1 Preparation of Sample Solution

B-3.3.1.1 Dissolve 0.44 gm sample to 400 gm pure water while stirring at 400 rpm for 90 minutes. Use jar tester to stir at 400 rpm.

B-3.3.1.2 Above sample solution is filter through a 80 mesh SS screen to remove residue.

B-3.3.1.3 After filtration take 50 gm of the solution in a beaker.

B-3.3.1.4 Dissolve 2.92 gm of NaCl into the solution with stirring. Use magnetic stirrer to dissolve it.

B-3.3.2 Determination of Viscosity and Conditions for Measuring Viscosity

B-3.3.2.1 Measure the viscosity of the salted polymer solution using Brookfield viscometer.

B-3.3.2.2 The condition for measuring the viscosity is given below:

Spindle — UL type spindle and UL adaptor

RPM — 60 rpm

Temperature — 25°C

Stop time — 3 min

B-3.4 Molecular weight (M_w) will be estimated from 0.1 % salt solution viscosity (SV) using the formula as below:

$$M_w = \{[(3.83 \times \text{SV}) + 0.64]/0.000373\}^{1.515}$$

where

SV = viscosity (cps) of 0.1% salt solution of product.

ANNEX C (Clause 6.5)

DETERMINATION OF SOLID CONTENT

C-1 PRINCIPLE

This test method is used to measure the solid content of the material.

C-2 APPARATUS

C-2.1 Oven with Circulation Hot Air

C-2.2 Electronic Balance

C-2.3 Desiccator

C-3 PROCEDURE

C-3.1 Weigh a weighing tray for the tare weight (W3).

C-3.2 Take 1.0 gm sample on the weighing tray and weigh it (W1).

C-3.3 Put the sample into the oven to dry at 105 ± 1 °C for 90 minutes.

C-3.4 Cool into desiccator and weigh the sample dries on the weighing tray (W2).

C-4 CALCULATION

Solid content (weight percent)

$$= [(W2 - W3) / (W1 - W3)] * 100$$

ANNEX D (Clause 4.2.5.1)

DETERMINATION OF RESIDUAL ACRYLAMIDE MONOMER

D-1 PRINCIPLE

This test method is used to measure the residual acrylamide monomer of the material.

D-2 APPARATUS

D-2.1 HPLC System

D-2.2 Electronic Balance

D-2.3 Test Sieve 60 Mesh (250 µm)

D-2.4 Measuring Flask (100 ml, 1 000 ml)

D-2.5 Whole Pipette

D-3 REAGENTS

D-3.1 Methanol

D-3.2 Phosphoric Acid

D-3.3 Acrylamide Standard

D-3.4 Sodium acrylate Standard

D-4 PROCEDURE

D-4.1 Sample Preparation

D-4.1.1 Crush granule sample to get powder by using mill.

D-4.1.2 Take about 10-20 g powder on 60 mesh sieve and shake it.

D-4.1.3 Collect powder of under 60 mesh test sieve. (powder sample).

D-4.1.4 Take 1 gm. powder sample in a glass bottle/conical flask for extraction, the volume of which is 20-30 ml.

D-4.1.5 Add 10 ml extractant (Methanol/water= 80/20 wt. %) and put a lid on the bottle.

D-4.1.6 Shake it among more than 17 hours by using a shaker that has 30 °C water baths to extract Residual monomer.

D-4.2 Quantitative Analysis by Using HPLC

D-4.2.1 After extraction, extraction liquid is filtered through a membrane filter and inject sample manually/set auto sampler.

D-4.2.2 Make HPLC system run.

D-4.2.3 Condition

D-4.2.3.1 Injection Volume — 5µl

D-4.2.3.2 Eluent — Pure water of pH= 3.4~3.6 with Phosphoric acid.

D-4.2.3.3 Flow rate — 1.0 ml/min

D-4.2.3.4 Column Type ODS Column (4.6 X 150 mm).

D-4.2.3.5 Column Oven — 25 °C.

D-4.2.3.6 Wavelength of UV — 210 nm

D-4.2.3.7 Stop Time — 13 min.

D-4.3 Preparation of Calibration Curve

D-4.3.1 Weigh 0.200 gm. of Acrylamide standard and 1.0 gm of Sodium acrylate standard.

D-4.3.2 Dissolve and dilute both of standards in a measuring flask with pure water to 1 000ml total. — Standard Solution (1).

D-4.3.3 Take 50 ml from Standard Solution (1) and dilute it in a measuring flask with pure water to 100 ml total — Standard Solution (2).

D-4.3.4 Take 50 ml of Standard Solution (2) and dilute it in a measuring flask with pure water to 100 ml total — Standard Solution (3).

D-4.3.5 Analyze Standard Solution (1) – (3) with the same manner (**D-4.2**) and determine calibration curve.

D-5 CALCULATION

The peak height corresponding to the acrylamide/Sod acrylate is measured and using the calibration graph, the conc. of residual monomer in the sample extract may be found.

ANNEX E
(Clause 4.2.5.2)

DETERMINATION OF BULK BROOKFIELD VISCOSITY

E-1 PRINCIPLE

This test method is used to measure the Bulk Brookfield Viscosity of the material. This viscosity is applicable only to PAM in form of emulsions, aqueous solutions, and aqueous dispersions.

E-2 APPARATUS**E-2.1 Brookfield Viscometer****E-2.2 Constant Temperature Water Bath****E-2.3 Electronic Balance****E-2.4 Jar Tester (Stirring Dissolver)****E-2.5 500 ml Griffin Beaker, 200 ml Tall Beaker****E-3 PROCEDURE**

E-3.1 Take a liquid polymer sample into the beaker. Avoid bubble formation during transfer.

E-3.2 Adjust temperature 25 °C.

E-3.4 Conditions

Spindle — No. 3 or other

RPM — 12

Temperature — 25 °C

Stop time — 3 min.

NOTE — For more precise measurement, selection of spindle and RPM must be done in order to have maximum shear (torque %) during viscosity measurement.

E-4 RESULT

E-4.1 Measure the viscosity using Brookfield viscometer.

ANNEX F
(Clause 4.2.5.3)

DETERMINATION OF SOLUTION VISCOSITY

F-1 PRINCIPLE

This test method is used to measure the solution viscosity of the material. This viscosity is applicable only to PAM in form of solids and gels.

F-2 APPARATUS

F-2.1 Brookfield Viscometer

F-2.2 Constant Temperature Water Bath

F-2.3 Electronic Balance

F-2.4 Jar Tester (stirring dissolver)

F-2.5 500 ml Griffin Beaker, 200 ml Tall Beaker

F-3 PROCEDURE

F-3.1 Preparation of Sample Solution

F-3.1.1 Dissolve 0.44 gm sample to 400 gm pure

water while stirring at 400 rpm for 90 minutes. Use jar tester to stir at 400 rpm.

F-3.1.2 Adjust temperature 25 °C.

F-3.2 Conditions

Spindle — No. 1-3 or other

RPM — 30

Temperature — 25°C

Stop time — 3 min.

NOTE — For more precise measurement, selection of spindle and RPM must be done in order to have maximum shear (torque %) during viscosity measurement.

F-4 RESULT

F-4.1 Measure the viscosity using Brookfield viscometer.

ANNEX G
(Foreword)

COMMITTEE COMPOSITION
Plastics Sectional Committee, PCD 12

<i>Organization</i>	<i>Representative(s)</i>
Central Institute of Plastics Engineering and Technology (CIPET), Chennai	PROF (DR) SHISHIR SINHA (Chairperson) DR S. N. YADAV DR SMITA MOHANTY (<i>Alternate</i>)
All India Plastics Manufacturers Association (AIPMA), New Delhi	SHRI DEEPAK BALLANI
Central Pollution Control Board, New Delhi	MS DIVYA SINHA SHRI C. K. DIXIT (<i>Alternate</i>)
Chemical and Petrochemical Manufactures Association (CPMA) New Delhi	SHRI MAHINDER SINGH
Coca-Cola India Pvt Ltd, Gurugram	SHRI VIRENDRA LANDGE SHRI RAJENDRA DOBRIYAL (<i>Alternate</i>)
Consumer Association of India (CONCERT), Chennai	SHRI G. SANTHANARAJAN SHRI M. R. KRISHNAN (<i>Alternate</i>)
CSIR-Central Food Technological Research Institute (CFTRI), Mysore	SHRI R. S. MATCHE SHRI KESHAVA MURTHY P. (<i>Alternate</i>)
CSIR-Indian Institute of Toxicological Research (IITR), Lucknow	DR V.P. SHARMA DR A.B. PANT (<i>Alternate</i>)
CSIR- National Chemical Laboratory (NCL), Pune	DR P. R. SURESHA DR R. V. GUNDLOORI (<i>Alternate</i>) SHRIMATI SANGEETA HAMBIR (<i>Alternate</i>)
Department of Chemicals and Petrochemicals, Ministry of Chemicals and Fertilizers, New Delhi	SHRI O. P. SHARMA SHRI VARUN SINGH POONIA (<i>Alternate</i>)
Food Corporation of India (FCI), Delhi	SHRI RAJAGOPAL A. SHRI A. K. U. B. SINGH (<i>Alternate</i>)
Food Safety and Standards Authority of India (FSSAI), Delhi	SHRI CHIRAG GADI
GAIL (India) Ltd, NOIDA	SHRI MANISH KHANDELWAL
Haldia Petrochemicals Ltd, Kolkata	SHRI RAJ K. DATTA SHRI SUVOMOY GANGULY (<i>Alternate</i>)
HMEL, Noida	SHRI VINEET KUMAR GUPTA SHRI ALAKESH GHOSH (<i>Alternate</i>)
Huhtamaki Paper Product Ltd (HPPL), Hyderabad	SHRI MUTHUSAMY CHOCKALINGAM SHRI AISHWARYA VANGE (<i>Alternate</i>)
IFCA, Mumbai	SHRI ATINDRA N. CHAUDHURI

<i>Organization</i>	<i>Representative(s)</i>
Indian Centre for Plastics in the Environment (ICPE), Mumbai	SHRI T.K. BANDOPADHYAY
Indian Institute of Packaging (IIP), Mumbai	SHRI MADHAB CHAKRABORTY DR TANWEER ALAM (<i>Alternate</i>)
Indian Institute of Technology (IIT), Delhi	SHRI ANUP K GHOSH
Indian Oil Corporation, R and D Centre, Faridabad	SHRI G. S. KAPOOR SHRI DHANANJAY SAHOO (<i>Alternate</i>)
Indian Pharmacopoeia Commission, Ghaziabad	DR JAI PRAKASH DR MANOJ KUMAR PANDEY (<i>Alternate</i>)
Indian Plastic Institute (IPI), Mumbai	SHRI V. B. LALL SHRI MIHIR BANERJI (<i>Alternate</i>)
Ministry of Environment and Forests (MoEF), New Delhi	SHRI SATYENDRA KUMAR SHRI AMIT LOVE (<i>Alternate</i>)
National Committee on Plasticulture Applications in Horticulture (NCPAH), Ministry of Agriculture and Farmers Welfare, Government of India, New Delhi	SHRI ANAND ZAMBRE SHRI KRISHNA KUMAR KAUSHAL (<i>Alternate</i>)
ONGC Petro Additions Ltd (OPAL), Gujarat	SHRI VIVEK MEHTA
Organization of Plastics Processors of India, Mumbai	DR SATYAPRASAD BHATTACHARYA SHRI DEEPAK LAWALE (<i>Alternate</i>)
Plastindia Foundation, Mumbai	DR E. SUNDARESAN SHRI HITEN BHEDA (<i>Alternate</i>)
Reliance Industries Ltd (RIL), Mumbai	SHRI S.V. RAJU SHRI AMIT SHAH (<i>Alternate</i>)
Sabic Innovative Plastics, Bengaluru	DR SUMANDA BANDYOPADHYAY SHRI SUNIL RAUTO (<i>Alternate</i>)
Shivalik Agro-Poly Products Ltd, Mohali	SHRI PANKAJ KUMAR MAHAJAN DR G. D. TYAGI (<i>Alternate</i>)
Technical Training and Research Centre (TTRC), Lohia Group, Kanpur	SHRI R. K. DWIVEDI
Voluntary Organization in Interest of Consumer Education (VOICE), New Delhi	SHRI M. A. U. KHAN SHRI H. WADHWA (<i>Alternate</i>)
The Toy Association of India (TAI), New Delhi	SHRI RAJESH ARORA SHRI R. K. VERMA (<i>Alternate</i>)
BIS Director General	SHRIMATI MEENAL PASSI, SCIENTIST 'E/DIRECTOR' AND HEAD (PETROLEUM, COAL AND RELATED PRODUCT DEPARTMENT) [REPRESENTING DIRECTOR GENERAL (<i>Ex-Officio</i>)]

Member Secretary
SHRI SHIVAM DWIVEDI
SCIENTIST 'B'/ASSISTANT DIRECTOR
(PETROLEUM, COAL AND RELATED PRODUCT DEPARTMENT), BIS

(Continued from second cover)

The composition of PAM may include additives / inactive content. Some of the materials which form the inactive part of PAMs include the following:

<i>Form</i>	<i>Additives / inactive contents</i>
Dry	Water, inert inorganic salts, inert organic compounds, etc.
Emulsion	Hydrocarbon oil, water, surfactants, etc.
Solution	Similar to Dry and Emulsion forms
Aqueous Dispersion	Water, salts, etc.
Gel	Water, salts, etc.

In the preparation of this standard, assistance has been derived from ANSI/AWWA-B453-13 approved by American Water Works Association (AWWA) on 9th June 2013 and approved by American National Standards Institute on 31st May 2013.

This Standard is under development on the recommendation of Department of Chemicals and Petrochemicals.

The composition of the Committee responsible for the formulation of this standard is given in Annex G (to be included).

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis shall be rounded off in accordance with IS 2: 2022 'Rules for rounding off numerical values (*second revision*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

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Amendments Issued Since Publication

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